High p_T hadron suppression in Au+Au collisions at RHIC due to final-state interactions

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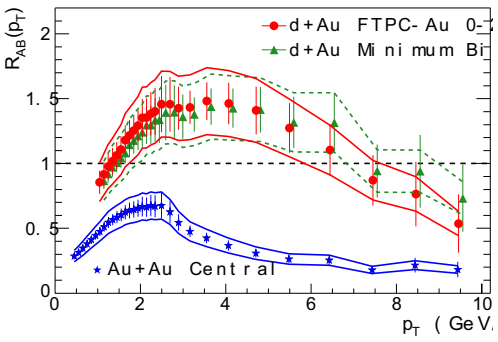

FIG. 1: Nuclear modification factor $R_{AB}(p_T)$ in central Au+Au collisions (blue stars) and minimum bias and central d+Au collisions at $\sqrt{s_{NN}}$=200GeV.

Charged hadron production at high p_T in central Au+Au collisions at RHIC is highly suppressed compared to the expectation for a superposition of incoherent inelastic N+N collisions[1, 2]. We have also observed that away-side jet correlations are suppressed in central Au+Au collisions while the near-angle correlations in all centralities of Au+Au are strikingly similar to those in p+p collisions at the same energy[3]. These effects could be attributed to gluon saturation in the initial nuclear wavefunction which suppresses the production rate for di-jets ("initial-state")[4] or to energy loss of the partner jet as it bores through the medium created in a heavy ion collision ("final-state" effect)[5, 6].

If the observed "jet-quenching" is due to initial-state nuclear effects, one would expect to see a similar suppression of hadron production and di-jet correlations in d+Au collisions at $\sqrt{s_{NN}}$= 200 GeV. If the observations are primarily due to final-state effects, one would expect comparable results in p+p and d+Au collisions, where no extended nuclear medium is produced. During 2003, RHIC undertook an extended run with d+Au collisions. We analyzed the data from these collisions using the STAR detector and compared the results on high p_T hadron production and di-jet correlations in p+p, d+Au and Au+Au collisions at $\sqrt{s_{NN}}$= 200 GeV.

Figure 1 shows the "nuclear modification factor", $R_{AB}(p_T)$, which is the ratio of charged hadron production in central Au+Au collisions and two centralities of d+Au collisions compared to the $\langle N_{bin}\rangle$-scaled spectrum in p+p collisions. In d+Au collisions, there is an approximately 20% enhancement of charged hadron production at intermediate p_T consistent with expectations from the Cronin effect, in contrast to the factor of five suppression in central Au+Au collisions.

Figure 2 shows the azimuthal correlations between a high p_T trigger particle with $4<p_T<6$ GeV/c and associated particles with $2<p_T<4$ GeV/c in p+p, d+Au and Au+Au collisions at $\sqrt{s_{NN}}$= 200 GeV. In all three cases the near-side correlations have similar shape and magnitude, consistent with standard jet fragmentation. The away-side correlations in p+p and d+Au collisions are very similar, while for central Au+Au collisions the away-side correlations are completely suppressed.

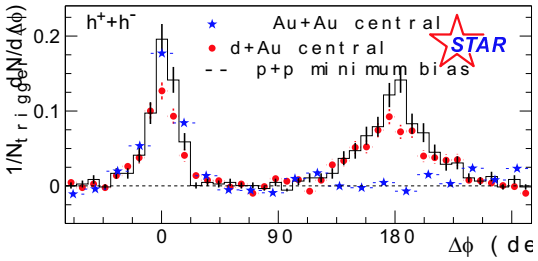

FIG. 2: Di-hadron correlations in central Au+Au collisions (blue stars), central d+Au collisions (red circles) and p+p collisions (black histogram) at $\sqrt{s_{NN}}$=200GeV.

These results demonstrate conclusively that the striking suppression phenomena observed in central Au+Au collisions are not due to gluon saturation in the initial-state nuclear wavefunction, but are rather due to the interaction of high energy partons or their fragmentation products in the dense medium created in such collisions[7].

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